

Singapore Management University Institutional Knowledge at Singapore Management University

Research Collection School Of Information Systems

School of Information Systems

1-2016

Demo: Sound localization using smartphone

Amit SHARMA

Singapore Management University, amit.2015@smu.edu.sg

Youngki LEE

Singapore Management University, YOUNGKILEE@smu.edu.sg

DOI: <https://doi.org/10.1145/2938559.2938584>

Follow this and additional works at: https://ink.library.smu.edu.sg/sis_research

 Part of the [Software Engineering Commons](#)

Citation

SHARMA, Amit and LEE, Youngki. Demo: Sound localization using smartphone. (2016). *MobiSys '16 Companion: Proceedings of the 14th Annual International Conference on Mobile Systems, Applications, and Services Companion, Singapore, June 26-30, 2016*. 119-119. Research Collection School Of Information Systems.

Available at: https://ink.library.smu.edu.sg/sis_research/3282

This Conference Proceeding Article is brought to you for free and open access by the School of Information Systems at Institutional Knowledge at Singapore Management University. It has been accepted for inclusion in Research Collection School Of Information Systems by an authorized administrator of Institutional Knowledge at Singapore Management University. For more information, please email libIR@smu.edu.sg.

Demo: Sound Localization using Smartphone *

Amit Sharma, Youngki Lee
Singapore Management University
Singapore
{amit.2015, youngkilee}@smu.edu.sg

1. INTRODUCTION

Smartphones based sound direction estimation can be helpful in many situations. For example, a deaf person in a meeting room can look at the smartphone to find out which direction the speaker is in and then he can look in appropriate direction to read lips/gestures of the speaker.

Many smartphones today come with two built-in microphones located at physically different positions. This difference in position can cause time difference of arrival (TDOA) of sound on both microphones. Value of TDOA for two microphones may vary depending on the location of sound source with respect to the smartphone. This time difference of arrival can be used to estimate incoming sound direction with respect to smartphone.

Challenges involved in angle estimation arise mainly because of heterogeneous characteristics of different types of sounds, small distance between two microphones on the smartphone and different positions of microphones on different devices. In this work we implemented TDOA based angle estimation for white noise as sound source. We look at this work as a first step towards achieving application described earlier.

TDOA based techniques have been used before for angle estimation as described by Murray et.al in [?]. Their work however requires dedicated hardware and hence need some preparatory setup. More than two microphones have also been used for angle estimation as described in [?]. This technique involved using 6 microphones placed at different heights.

Our approach uses a commodity smartphone and requires no preparatory setup. We don't use any signal processing and there are no requirements for internet connectivity. Application computes TDOA using signal cross-correlation and then maps the TDOA to appropriate angle. Angle is measure anti-clockwise with respect to the camcorder of the

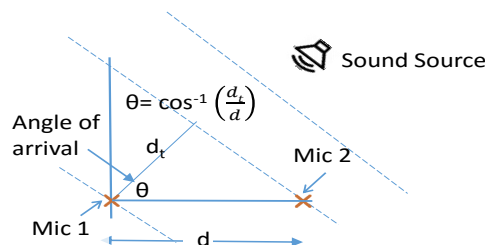


Figure 1: Angle of Arrival Derivation from Time difference

smartphone.

Figure 1 shows angle derivation for a given value of time delay. Sound source lies in first quadrant and d_t is difference in distance traveled by sound to reach both microphones and d is distance between two microphones of the smartphone.

If the line connecting both microphones is assumed as x-axis then using our technique, we could localize user in 0 to 180 degree horizontal plane with respect to the phone.

In our experiments, we estimated 9 different angles (0° , 20° , 40° , 60° , 90° , 120° , 140° , 160° and 180°). Results of estimation reflects that this TDOA based approach can work for white noise with a maximum estimation error of 3° and a estimation delay of less than 1 second.

2. DEMONSTRATION

We will demonstrate our Android application using Samsung Galaxy S3 smartphone and white noise as the sound source. We will place the sound source at 1 meter distance from the smartphone and play the sound. Then we move the sound source in 180 degree horizontal plane and show the angle estimated by the system.

3. REFERENCES

- [1] Y. Guo and M. Hazas. Acoustic source localization of everyday sounds using wireless sensor networks. In *Proceedings of the 12th ACM International Conference Adjunct Papers on Ubiquitous Computing - Adjunct*, UbiComp '10 Adjunct, pages 411–412, New York, NY, USA, 2010. ACM.
- [2] J. C. Murray, H. Erwin, and S. Wermter. Robotics sound-source localization and tracking using interaural time difference and cross-correlation. In *Proceedings of NeuroBotics Workshop*, pages 89–97, 2004.

*This research is supported by the National Research Foundation, Prime Minister's Office, Singapore under its IDM Futures Funding Initiative.

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).

MobiSys'16 Companion June 25-30, 2016, Singapore, Singapore

© 2016 Copyright held by the owner/author(s).

ACM ISBN 978-1-4503-4416-6/16/06.

DOI: <http://dx.doi.org/10.1145/2938559.2938584>